measurements, and/or a specific type of channel units, and/or channel units to be used for a specific cooperative multipoint transmission.

[0087] Based on the report, a transmission scheme may be adapted. For example, for the transmission scheme only those channel units are used for which no error was reported.

[0088] Moreover, a cooperation area including a plurality of channel units may be defined, the cooperation area comprising a size which depends on the number of channel units, and the size of the cooperation area may be reduced by taking into account channel units for which errors were reported.

[0089] A control message may be sent to at least one user equipment, the control message including information regarding the size of the cooperation area, wherein this information may indicate channel units of the cooperation area which are to be used and/or channel units of the cooperation area which are not to be used.

[0090] The reports may include further information about the strength and/or the phase of the error. Based on this information, the transmission scheme may be adapted, e.g., a precoder may be correspondingly adapted.

[0091] The methods and processes according to the third and fourth aspects and/or their modifications may be carried out by a network control element such as an eNB or a part thereof.

[0092] According to a fifth aspect of the present invention a computer program product is provided which comprises code means for performing a method according to the second or fourth aspects and/or their modifications when run on a processing means or module. The computer program product may be embodied on a computer-readable medium.

[0093] It is to be understood that any of the above modifications can be applied singly or in combination to the respective aspects and/or embodiments to which they refer, unless they are explicitly stated as excluding alternatives.

BRIEF DESCRIPTION OF THE DRAWINGS

[0094] These and other objects, features, details and advantages will become more fully apparent from the following detailed description of embodiments of the present invention which is to be taken in conjunction with the appended drawings, in which:

[0095] FIG. 1 shows simplified structures of network elements according to an embodiment of the present invention,

[0096] FIG. 2 illustrates a typical normalized means square error (NMSE) over prediction horizon in wavelengths,

[0097] FIG. 3 illustrates a typical predictive scheduler,

[0098] FIG. 4 illustrates a prediction NMSE error in dB for a moving UE for 100 PRBs,

[0099] FIG. 5 illustrates a norm of error between predicted and real CSI for 36 UEs at one site with 3 cells and 4 antennas per cell according to an embodiment of the present invention,

[0100] FIG. 6 illustrates a basic cooperation area of one site according to an embodiment of the present invention,

[0101] FIG. 7 illustrates an effect of one single errored channel component on the Rx matrix Y according to an embodiment of the present invention,

[0102] FIG. 8 illustrates a simulation of the effect of one single errored channel component on the Rx matrix Y according to an embodiment of the present invention,

[0103] FIG. 9 illustrates a strategy for precoder adaptation according to an embodiment of the present invention, and

[0104] FIG. 10 illustrates an OP CoMP scheduler according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0105] In the following, description will be made to embodiments of the present invention. It is to be understood, however, that the description is given by way of example only, and that the described embodiments are by no means to be understood as limiting the present invention thereto.

[0106] Before describing embodiments of the present invention, however, the problem underlying the present application is summarized again.

[0107] A general goal of embodiments of the invention is to approach the performance bound of a full JT CoMP system with the minimum possible complexity and maximum robustness by a suitable combination of techniques like coordinated scheduling, dynamic cell selection, network assisted receivers, antenna tilting etc.

[0108] In particular, a main observation for embodiments of the present invention is that (probably all) channel prediction techniques—like for example Kalman filtering—experiences a strong variance in the prediction quality over different subcarriers or in case of LTE over different physical resource blocks (PRB).

[0109] FIG. 2 illustrates a typical normalized means square error (NMSE) over prediction horizon in wavelengths. After 0.2λ the NMSE is already close to -5 dB and at 0.5λ the prediction fails completely. Interestingly the fast increase of the normalized mean square error (NMSE) over prediction time (FIG. 2) will be caused often by few to very few channel components on few specific physical resource blocks (PRB).

[0110] FIG. 4 illustrates an example for a prediction NMSE error in dB for a moving UE for 100 PRBs. The RF wavelength λ is 11-12 cm. In FIG. 4 the NMSE error in dB is coded by different grey shades for an artificial radio channel for an increasing distance from the location where the CSI prediction has been done for a bandwidth of 100 PRBs.

[0111] While prediction for some of the subcarriers or PRBs is fine for one or even two λ on other resources the NSME is in the range of -10 dB already after two to four cm (0.2 to 0.4λ). Important is that a few bad predictions will dominate the overall NMSE calculation over all PRBs. The overall NMSE is therefore not a good criterion for evaluation of the potential of channel prediction. Note in FIG. 2 the variance of the NMSE is indicated by the solid perpendicular thick lines.

[0112] From a system point of view it is beneficial to exploit the very limited number of failing predictions (bad PRBs) as it allows to just report these few miss-predicted channel components to the JT precoder. This reporting has to be done over a low rate low latency pre-scheduled UL control channel so that the JT precoder can be adapted accordingly based on latest possible information.

[0113] The main difference compared to SoA robust precoding as proposed in Artist4G is that the reliability information feedback gives just a probability that a certain channel component might fail in the future, while reporting of the few bad channel components gives the precoder accurate information about good and badly predicted channel components.